

ON THE MODULATION OF COUPLED OSCILLATOR ARRAYS IN PHASED ARRAY BEAM CONTROL

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Over the past several years, coupled oscillator arrays have been under development as a means of providing, in a simple manner, control over the aperture phase of an array antenna thus achieving steering of the beam. The oscillators are arranged in linear or planar arrays in which they are each coupled via transmission lines to their nearest neighbors in such a manner as to cause them to mutually injection lock and oscillate as an ensemble. It has been shown that in the absence of any external injection signals they oscillate at the average of their free running frequencies. Under these conditions the relative phases of the oscillator output signals is a function of the free running frequencies of the oscillators. Assuming that they are voltage controlled oscillators (VCOs), the phase control is accomplished by application of appropriate biasing voltages. It has been shown that the slope of linear phase progressions across the array can be controlled by adjustment of the bias on only the end oscillators of a linear array. [R. A. York, *IEEE Trans.*, MTT-41, 1799-1809, 1993][P. Liao and R. A. York, *IEEE Trans.*, MTT-41, 1810-1815, 1993] Analogously, such slope control can be accomplished by biasing only the perimeter oscillators of a planar array. A body of theory capable of predicting the dynamic behavior of such arrays has also been developed. [R. J. Pogorzelski, P. F. Maccarini, and R. A. York, *IEEE Trans.* MTT-47, 463-470, 1999] [R. J. Pogorzelski, P. F. Maccarini, and R. A. York, *IEEE Trans.* MTT-47, 471-478, 1999][R. J. Pogorzelski, *Nat. Radio Sci. Mtg Dig.*, pg. 296, Boulder, CO, Jan. 1999][R. J. Pogorzelski, *IEEE AP-S/URSI Int'l Symp. Dig.*, pg. 2382, Orlando, FL, July 1999] In addition, a seven element experimental array has been fabricated and tested. This array is used in the work described here.

The primary objective of the work to be presented is investigation of the modulation characteristics of a linear coupled oscillator controlled phased array. It is shown that modulation cannot be effectively applied unless all of the oscillators are modulated simultaneously. Using the seven element experimental array, a low frequency square wave was applied simultaneously to all of the oscillator tuning ports and the resulting phase dynamics observed on a multi-channel oscilloscope. These measurements verify certain aspects of the theoretical predictions concerning the modulation dynamics of the array under both free running and externally injection locked conditions and thus enhance the credibility of the continuum model underlying the theory.